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FARMERS' BULLETIN 1142
UNITED STATES DEPARTMENT OF AGRICULTURE

GROWING CRIMSON CLOVER



CRIMSON CLOVER is a handsome fall-planted annual, widely cultivated in the Middle Atlantic and Southeastern States for forage, a cover crop, and green manure.

Crimson clover is commonly sown in corn at the last cultivation. If the soil is heavy, a better practice is to sow after a crop of small grain or on other land which can be specially prepared.

Crimson clover will grow on poorer soil than most clovers and is not particularly dependent upon lime. For this reason it has been widely used for restoring the productivity of soils which have been abused. A more important function is to maintain crop yields on soils which are already moderately rich.

The most common difficulty in growing crimson clover is the killing of the young stands by drought. This is best prevented by the preparation of a fine, moist, and firmly compacted seed bed.

August and September are the best months for sowing crimson clover, the exact date depending upon the condition of the soil. Either hulled or unhulled seed may be used, the latter giving somewhat greater certainty of a stand.

Crimson clover is often sown with a nurse crop of buckwheat or cowpeas, to protect it from the sun. A light covering of straw is also effective.

Combinations of crimson clover with oats, hairy vetch, or other fall-sown forage crops give somewhat higher yields and a surer stand than crimson clover alone.

No insects trouble crimson clover seriously, and the only severe disease is the stem-rot, or wilt.

Contribution from the Bureau of Plant Industry

WM. A. TAYLOR, Chief

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GROWING CRIMSON CLOVER.¹

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C RIMSON CLOVER is an annual or winter annual true clover, resembling common red clover in size and general appearance, the most noticeable difference being the flower heads, which are long, narrow, and pointed instead of short, spherical, and compact (fig. 1). The individual flowers of this clover are commonly of a rich scarlet color, and as the heads are borne mostly on the ends of the stems, a field of crimson clover in full bloom presents a strikingly brilliant appearance. Because of the color of the flowers, crimson clover is often termed "scarlet clover," although it is also known, less commonly, as "French clover," "Italian clover," "German clover," "incarnate clover," and "annual clover." It is the only annual true clover that is of more than incidental agricultural importance in the eastern United States.

Probably the most important characteristic of crimson clover is its ability to grow and make its crop during the fall and early spring, when the land is not occupied by the ordinary summer-grown crops. In sections where it succeeds, it can be sown following a grain crop or in an intertilled crop in late summer and is ready to harvest for hay, to pasture, or to turn under as green manure in time to plow the land for spring-seeded crops, such as corn or cotton. South of central Delaware it may even be cut for seed and the stubble plowed under in time for seeding a quick-maturing strain of corn. Because it can be grown during the offseason of the year, crimson clover is one of the most economical legumes for green manuring, and it has

¹ This bulletin is a revision of Farmers' Bulletin 550, entitled "Crimson Clover: Growing the Crop," by J. M. Westgate, formerly Agronomist in Charge of Clover Investigations, Office of Forage-Crop Investigations. The illustrations and some of the subject matter of the old bulletin are retained in the present issue.

been largely used for that purpose in the regions to which it is adapted. The many uses to which this crop may be put merit a careful study of the best methods of establishing a stand of this clover on the farm.

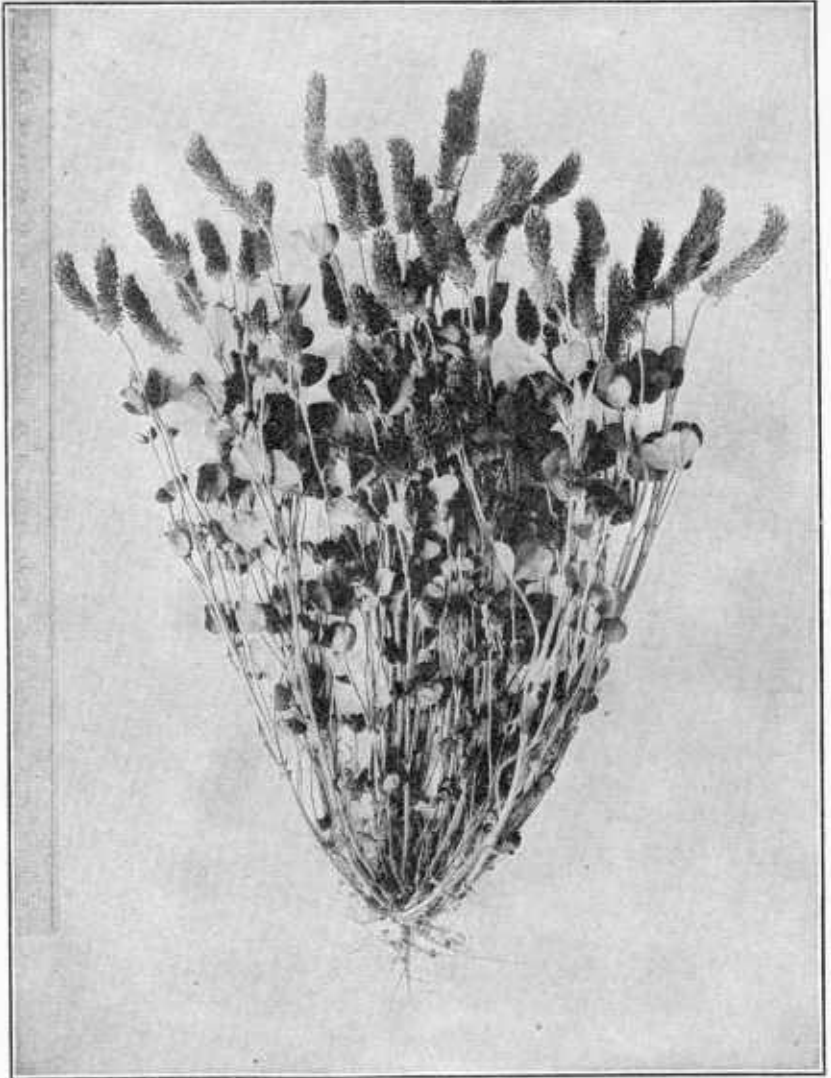


FIG. 1.—A single plant of crimson clover.

HISTORY AND ADAPTATIONS.

Crimson clover is a native of Europe, where it is cultivated as a forage and green-manuring crop in Italy, France, Spain, Germany, Austria, and Great Britain. Large quantities of crimson-clover seed

are exported from Europe to the United States, especially from the districts of central France, where crimson clover is the premier leguminous forage plant.

Crimson clover was introduced into this country as early as 1818, and the seed was widely distributed by the United States Patent Office in 1855. The plant was at first regarded more for its ornamental value than as a forage plant, however, and it was not until about 1880 that its value for agricultural purposes began to be appreciated.

At present crimson clover is grown most widely in the lighter sandy areas of the Atlantic Coastal Plain, where the soil is not very rich and the winters are not severe. (Fig. 2.) The plant does not with-

stand either extreme cold or extreme heat, and its culture is therefore limited to regions which enjoy at some time during the year a long period of relatively mild, moist weather. Ordinarily, this clover does not survive the winter in latitudes north of southern Pennsylvania, while in some of the Southern States it is frequently killed by dry, hot weather in the fall

or spring. It succeeds well in the humid regions near the Gulf of Mexico and in the Pacific Northwest, but in these areas it is not widely grown.

Normally, crimson clover is a winter annual comparable to winter wheat; that is, it is planted in the fall, lies more or less dormant over winter, grows rapidly in the spring, and dies, after going to seed, early in the summer. Where the summers are not too hot it can be planted in the spring and grown as a summer crop, but for this purpose other clovers are usually preferred.

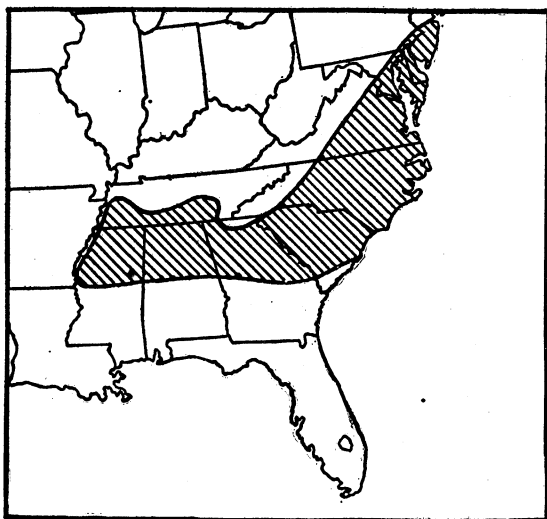


FIG. 2.—Map of a part of the United States, showing the region where crimson clover is most widely grown.

VARIETIES.

Crimson clover is exceedingly variable both in color of flower and in time of maturity. These variations are particularly noticeable in fields planted from a mixed lot of seed, the flowers presenting a range in color from nearly pure white to a deep purplish red and the

seeds a difference in date of ripening of more than a month. Since crimson clover is thought to be mainly self-pollinated, it is easy to fix these qualities by selection and to establish definite varieties.

In Europe six or seven different varieties of crimson clover are recognized and sold by seedsmen, varying from extra early crimson flowered to extra late white flowered and from very hardy to non-hardy. By the use of a succession of these varieties the European farmer is able to spread his harvest over six or seven weeks instead of having it concentrated within a few days, as in America. Similarly, the culture of the plant has been extended northward from Italy to Sweden by means of hardy strains. A wild form of crimson clover having yellowish flowers and hairy foliage occurs in southern and eastern Europe and in England, but it is not of economic value.

In America no sharply defined varieties of crimson clover are recognized, except a white-blooming variety which is sold in the South and is two weeks later than the ordinary crimson-flowered sort. Hardy strains have been developed and used in a small way in Massachusetts and Ohio, but these are not commercially available.

USE IN THE ROTATION.

SEEDING IN INTERTILLED CROPS.

In former years a large percentage of the crimson-clover acreage was seeded in corn or other intertilled crops at or shortly after the time of the last cultivation. In most of the crimson-clover area it is possible to make such a seeding, obtain a good growth during the fall and early spring, and mow or plow under the clover in time for breaking up the land for another crop of corn. This has been the standard method of growing this clover, and it is still the leading practice in many of the older sections. Corn in the summer with crimson clover in the winter is a cheap and convenient method of growing a cash crop and a restorative crop the same year, and the reputation of crimson clover as a crop increaser is largely based on this simple rotation. Instances are by no means rare where the yield of corn has been gradually increased from 10 bushels per acre to as high as 70 bushels by this means.

The difficulty with this method is the possibility of the stand of young clover failing through drought. The growing corn makes a heavy demand on the soil moisture, and if there is not enough moisture for both clover and corn the latter gets the larger share and the tender clover plants are likely to succumb. Because of the risk involved, farmers in the upland sections are seeking other and more reliable methods of seeding, and the sowing of crimson clover in corn is gradually decreasing.

Where the danger from fall drought is not serious, crimson clover may be sown in corn at the time of the last cultivation or when the corn leaves have just begun to wither. South of central Virginia there is likely to be much hot weather after the corn is laid by, in which case it is best to delay the seeding of the clover until after the first rain. The appearance of a field of crimson clover seeded in corn the previous summer is shown in figure 3.

South of southern Virginia crimson clover can be seeded in cotton, provided the field is free from crab-grass and other weeds and the soil is not too dry. In the extreme north of the cotton belt the seed may be sown at the last working of the cotton; farther south this occurs too early and it is necessary to wait for a rain, which often comes at about the time of the first picking.

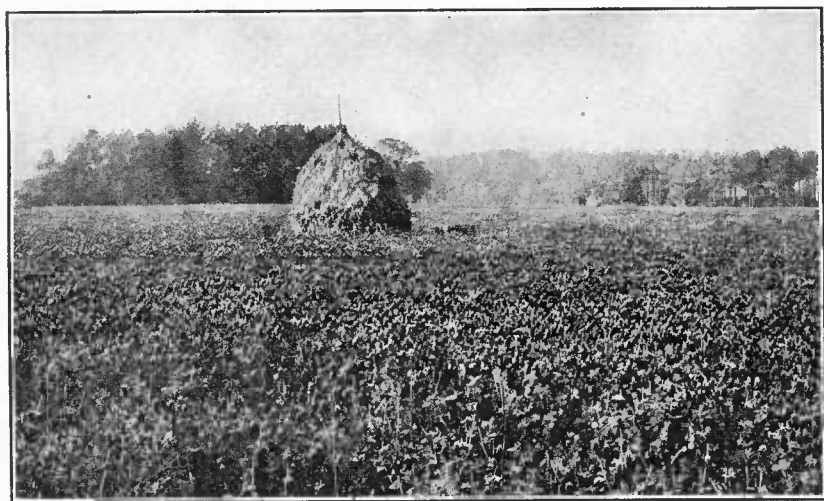


FIG. 3.—Crimson clover in an old cornfield. The clover was seeded in the corn at the last cultivation. A fodder stack is to be observed in the middle foreground. The cornstalks have been removed to avoid difficulty in mowing the clover.

Crimson clover may be seeded in practically any of the cultivated truck crops which receive their last cultivation from 8 to 12 weeks before the first frost. It is not practicable to seed the clover in late potatoes, sweet potatoes, or other root crops, as the digging in the fall practically destroys the clover.

Ordinarily, crimson clover does not succeed when sown in cowpeas, sorghum, or watermelons, owing to the heavy shade cast by these crops. It can, however, be seeded in tobacco, tomatoes, cultivated soy beans, and cantaloupes.

SEEDING AFTER AN EARLY-MATURING CROP.

Seeding crimson clover in an intertilled crop is successful mostly on sandy soils, which can easily be prepared for seeding even in mid-summer. On clay soils and in weedy fields this method of seeding

is likely to be unsatisfactory. Such soils are usually hard and dry in August and can with difficulty be brought into condition for a seed bed, with the result that a large percentage of such seedings fail. A better plan on clay soils, and on sandy soils in many cases, is to seed the crimson clover on specially prepared ground from which all other crops have been removed. Such ground can be made as fine and firm as desired. Furthermore, the clover after planting does not have to compete with another crop for the soil moisture. This method is somewhat more troublesome than planting in intertilled crops, but the greater certainty of getting a stand more than offsets the greater cost. Planting crimson clover on specially prepared ground has extended the culture of the plant to regions where it was not hitherto grown and is increasing the reliability of the crop in sections where it has been long established.

In the ordinary rotation, crimson clover follows a crop of small grain. However, it may follow any crop that is removed 8 to 10 weeks before frost, or it may be seeded on fallow ground. Ground from which early potatoes have been removed is especially favorable for the establishment of a stand of this clover. The residual effect of the fertilizers used on potatoes is partially responsible for this, while the well-settled seed bed, which requires only leveling and harrowing, also presents favorable conditions for the crimson-clover seedlings.

In many parts of the South crimson clover can be seeded in corn stubble if an early variety of corn has been used. Although there is some risk that the clover may not make enough growth before winter if seeding is delayed until the corn is harvested, the danger of losing the stand is not as great as if the clover were seeded earlier, while the corn was standing.

Crimson clover is sometimes seeded after a grass or clover crop if the rainfall in July is sufficient to cause the sod to decay. In the far South it can be planted after peanuts, while in all sections it can be sown as a catch crop on land where cotton or other crops have died early in the season.

REQUIREMENTS FOR OBTAINING A STAND.

Probably the difficulty most commonly experienced in growing crimson clover is failure to obtain a satisfactory stand. Sometimes the seed does not germinate well; more commonly good germination is secured, but the seedlings wither and die before they can become established. Frequently not more than 50 per cent of the plants survive the first three weeks, while a complete failure of the crop is a common risk even in the sections where crimson clover is most widely grown.

The most common cause of failure to obtain a stand is hot, dry weather after planting. The seedlings of crimson clover are tender,

succulent, and shallow rooted and are easily killed by lack of moisture. Unfortunately, in most of the crimson-clover area the weather during late August and early September is very likely to be hot and droughty, making the planting of the clover at that time rather hazardous. Some farmers attempt to avoid this difficulty by planting either in early summer or in October, after the fall rains; there is danger, however, that the plants will make too much or too little growth to survive the winter. In the long run it is probably better to plant at the regular time and depend upon thorough preparation of the seed bed to offset any deficiency in the rainfall.

SOILS.

Crimson clover can be grown successfully on almost any type of soil if it is reasonably rich, well drained, and supplied with organic matter and the proper inoculating bacteria. Probably two-thirds of the crimson-clover acreage is found on the sandy soils of the Atlantic Coastal Plain, but the crop is not necessarily restricted to sandy soils and is in fact



FIG. 4.—A crimson-clover failure on ground too poor in humus.

increasing in importance on the red-clay soils of the Piedmont region and in the limestone valleys of Virginia and Tennessee.

Crimson clover has been an important factor in increasing yields on soils that have been abused, but it is not a crop for land which is naturally very poor. It does not do well on rough, newly cleared

areas, raw subsoil, hard, dry clay, or sterile sand. (Fig. 4.) For such soils soy beans, cowpeas, and velvet beans are better suited and should be used for the first three or four years until crimson clover can be successfully grown. Crimson clover can be made to grow on poor soils, provided they are specially prepared by liming, manuring, and inoculating. In general, however, crimson clover is a crop for maintaining soils which are already fairly productive rather than one for inducing productivity in soils where it is quite lacking. If there is any doubt whether the soil is suitable for crimson clover, a small plat should be prepared under field conditions and planted one year for trial.

PREPARATION OF THE SEED BED.

To secure a full, even stand of crimson clover with any degree of regularity the seed bed should be well and thoroughly prepared.

The soil should be firm, moist, well settled, and fine on top. Only indifferent success can possibly be expected if the seed is scattered on

land which is loose, dry, and full of hard lumps and trash. A loose seed bed dries out quickly, heaves during the winter, and on some soils blows and washes badly.

On the other hand, the seed bed should not be too hard, for although this clover often grows successfully on soil which

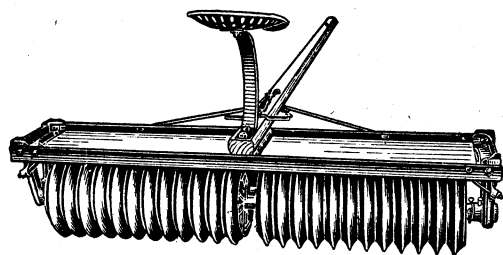


FIG. 5.—A corrugated roller or pulverizer, an excellent implement for preparing the seed bed for crimson clover.

would be too solid for corn, there must be at least enough loose soil on the surface to cover the seed. Thorough preparation is the very best insurance against failure of the stand through drought or winter-killing, and the most successful growers sow crimson clover on land as well prepared as that for wheat.

To secure a fine, firm seed bed without drying out the surface soil, the land should be prepared with as few operations as possible. A single working when the soil is in a moist, crumbly condition is better than half a dozen workings when the soil is too wet or too dry. In very sandy soils, or soils which do not form a crust, the only preparation needed is to keep down the weeds.

An excellent tool for making the seed bed is the corrugated roller or pulverizer (fig. 5). This implement is an improvement over the old plain roller for breaking clods and is unexcelled for keeping the surface soil moist. It can be used after plowing and again before planting, and even after planting if the soil needs to be compacted. Rolling of some kind to firm the soil is especially important on sandy soils, but it is equally beneficial on clay soils if they are cloddy.

When clover is seeded in an intertilled crop, such as corn, cotton, or tomatoes, the customary cultivation received by these crops is ordinarily sufficient preparation for crimson clover. In sandy soil the clover is often seeded without any immediate preparation, but a light stirring with a harrow-toothed cultivator is desirable if the ground is hard. If the clover is to be used for hay or seed, the preceding crop should be laid by level rather than in ridges. This will facilitate cutting the clover.

Where crimson clover is seeded after a crop of small grain, the stubble should be plowed or disked as soon as possible after the grain is cut. Stubble land dries out quickly, partly because the soil is suddenly left bare and partly because of the drain on the soil moisture by the crops of ragweed and other coarse-growing weeds which always follow a grain crop. Unless the soil is cultivated at once it becomes very difficult to obtain anything like an ideal seed bed for crimson clover. This difficulty is usually more pronounced after oats and barley than after rye and wheat. Ordinarily the best practice is to disk the grain stubble within a week after harvest and harrow every week, or at least after every rain, in order to settle the ground, destroy the weeds, and assist in holding the moisture pending the time of seeding the clover. Plowing the stubble is more expensive than disking and requires that the ground be allowed to settle for a month or six weeks in order to secure a firm seed bed. Plowing is an advantage in a wet season, because plowed ground dries readily; it is a disadvantage in a dry season for the same reason.

FERTILIZERS.

On moderately rich soil the fertilizer applied to the preceding crop is sufficient to produce a good crop of crimson clover. This is especially true where the clover follows such crops as potatoes or tomatoes, which ordinarily are heavily treated with fertilizers. It is important to realize, however, that crimson clover has a very short period of growth, and that to make a vigorous growth it must have a good supply of plant food. On sandy soils where fertilizers have not recently been applied it is often the practice to apply from 150 to 200 pounds of acid phosphate, with some potash fertilizer if it can be afforded. On clay soils 200 or 300 pounds per acre of acid phosphate ordinarily are sufficient. On many soils a light application of nitrate of soda will assist materially in giving the young clover plants a good start and often will enable them to withstand the effects of a late drought or severe winter which otherwise might have injured the stand. If the seeding has been delayed, as by waiting for suitable rains, an application of not more than 75 pounds of nitrate of soda per acre will stimulate the young plants and enable them to make a better growth before winter.

Fertilizer is usually applied at seeding time, but a few farmers have been found who apply it as a top-dressing very early the following summer, giving as a reason that there is then no loss from winter leaching and that by this method the plants are nourished at the time they are making their most vigorous growth. Such top-dressings of fertilizer should not be made while the leaves are wet with rain or dew. Where stable manure is applied to crimson clover very marked results follow. It may be spread just before seeding when the clover is not grown in an intertilled crop, or it may be applied as a top-dressing in winter or very early spring.

The more vigorous the growth that can be induced by the application of suitable fertilizers the more marked will be the increase in the yield of the succeeding crops. On soil in a low state of productivity the use of a reasonable amount of fertilizer will often enable a successful crop of clover and succeeding crops to be produced, where had not the fertilizers been applied the clover would have failed. Furthermore, the following crop, particularly if it be corn, would also fail to give the increased yield which follows a successful stand of crimson clover.

An application of barnyard manure will be found to be especially effective in obtaining a stand of crimson clover on any thin, galled spots in the field. The manure should be worked into the ground before seeding, and, if possible, a second application as a top-dressing should be given a day or two after planting. The top-dressing stimulates the seedlings and if strawy helps to protect them from the August sun.

LIME.

Crimson clover is not as dependent on lime as red clover and alfalfa, being more like alsike clover in this respect. It does not thrive on soils which are very "sour," but on well-drained soils in a productive condition crimson clover frequently makes a vigorous growth, even though the soil may show a high lime requirement. The stands are usually more uniformly good over the limed parts of such fields than on the unlimed parts, although it is sometimes questionable whether the benefit derived from liming is profitable. Liming is more often desirable on clay soils than on sandy soils, and usually gives better results when used in conjunction with fertilizers than when used alone. On light sandy soils deficient in humus burnt lime may be actually injurious. In considering the advisability of applying lime one must not lose sight of the need of lime on the part of such other crops as corn, cantaloupes, or peaches, which are either grown with or follow the clover. Inasmuch as the effect of liming varies greatly in different localities, it is suggested that small plats be treated experimentally at different rates before any considerable areas are limed.

INOCULATION.

A large part of the value of all clovers lies in their ability to utilize the nitrogen of the air and add it to the soil. When grown on rich land, the clovers, like many other plants, use the nitrogen already present in the soil and are not stimulated to contribute any to their own support or to the support of other crops. To enable the clover to use the nitrogen in the air the presence of the proper nodule-forming bacteria in the soil is necessary.

Fortunately, most of the soils in the crimson-clover sections appear to be already inoculated, and artificial inoculation is not often necessary, except on soils new to the crop. Crimson clover is inoculated by the same strain of bacteria which occurs on the roots of the other true clovers; consequently, a field which has produced a good stand of red, mammoth, alsike, white, hop, Carolina, rabbit's-foot, or buffalo clover is usually inoculated sufficiently for crimson clover. Sweet clover, Japan clover, and bur clover are not true clovers and are inoculated by a different strain of bacteria.

The importance of inoculation is well shown by an experiment conducted by the Alabama Agricultural Experiment Station. In this experiment yields of 4,057 and 6,100 pounds of crimson-clover hay were secured on inoculated soils, while on corresponding areas which were not inoculated the yields were 761 pounds on one area and nothing on the other.

The soil can be inoculated artificially by means of pure cultures of the bacteria or by the transfer of a small quantity of soil from another clover field.¹ The latter method is the more certain, but is open to the danger of introducing noxious weeds, insects, and plant diseases, especially if the soil is brought from a distance. The presence of stem-rot in many sections makes the use of soil especially dangerous. This disease can be carried with the soil from field to field.

SEEDING.

TIME OF SEEDING.

Crimson clover is usually sown between August 15 and October 1, the general rule being to plant about 60 days before the first killing frost is expected. South of Virginia crimson clover can be seeded as late as November 1, although if planted late more seed should be used and a light dressing of nitrate of soda applied, in order to stimulate the young plants. Seeding earlier than August 1 is seldom advisable unless the crop is sown with some other crop the shade of which will hold it back.

¹ Sufficient pure culture for inoculating seed for 1 acre can be secured free from the United States Department of Agriculture. Full directions for using the culture accompany each bottle. Directions for inoculating by the soil-transfer method can also be obtained from this Department.

The exact date of planting depends almost entirely upon the moisture content of the soil. The principal condition to avoid is planting when the soil contains just enough moisture to germinate the seeds, but not enough to keep the plants growing. Usually it is better to plant when the soil is quite dry than when it is slightly moist, for in dry soil the seeds, if properly buried, lie without germinating and are ready to grow vigorously at the first rainfall. The most favorable time for seeding is just before or just after a good rain, when the soil is moist enough to form a ball in the hand.

RATE OF SEEDING.

The ordinary rate of seeding crimson clover is 15 pounds per acre, although the rate varies according to conditions. From 12 to 15 pounds per acre are usually sufficient when growing the crop for seed or when the soil is unusually rich. On poor soil, dry soil, or on soil which has not previously produced crimson clover 18 to 22 pounds of seed give better assurance of a stand. Heavy seeding is also desirable when planting late in the season or when a heavy crop is wanted for green manure early in the spring.

Theoretically, 2 pounds of seed per acre would provide six plants for every square foot, which is a satisfactory stand. Under ordinary circumstances, however, it is necessary to allow for some of the seed being too deep, or too shallow, or failing to germinate, and for a certain percentage of winterkilling. It is also well to have a fairly thick stand of the young plants, so that the ground may be well covered during the early fall and thus prevent soil washing and the growth of winter weeds.

METHODS OF SEEDING.

The most common method of seeding crimson clover in intertilled crops is to scatter the seed broadcast with a rotary seeder or by hand. (Fig. 6.) In order to place the seed on a fresh, moist seed bed it is commonly broadcasted immediately behind the cultivator at the last cultivation and is covered at once by a second cultivator. In tall corn the seed may be sown from horseback, the ears of the horse being covered with small bags to prevent the entrance of the flying seed. Slightly more seed is required when seeding in tall corn, as some seed catches in the corn plants. When seeding in cotton care must be taken to avoid injury to the opening bolls, which are easily knocked off or torn. This is best done by seeding by hand, covering the seed with a piece of brush dragged down the rows.

In low-growing truck crops and on fallow ground crimson clover can be seeded with a wheelbarrow seeder. This implement distributes the seed more evenly than can be done by hand or with the rotary seeder, especially when planting a mixture of crops. The wheel-

barrow seeder being somewhat awkward to handle is better adapted to smooth, level fields than to hillsides.

Probably the very best method of seeding crimson clover is with the special clover or alfalfa drill. Where enough clover is grown to warrant its use this implement is to be highly recommended. The seed is sown in 4-inch rows at just the proper depth and with the right pressure, and the fertilizer is placed exactly under each row, where it will be immediately available to the seedlings. Drilled clover requires less seed than broadcasted clover and produces a more even and certain stand.

In place of the special clover drill an ordinary grain drill equipped with a clover-seed attachment can be used with good results. Special spouts should be arranged to lead from the clover-seed box back of

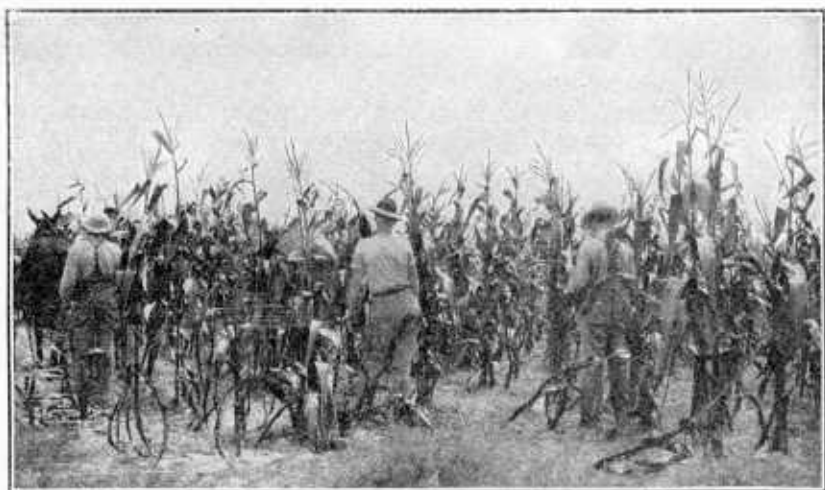


FIG. 6.—Seeding crimson clover in corn at the last cultivation.

the shoes or disks, in order to deposit the seed directly in the furrow. Chain furrow closers are best for covering the seed, as they leave the furrows broad and flat instead of V shaped and lessen the danger of the seedlings being covered with soil during a hard rain.

For use in intertilled crops there are several types of 1-row drills, the best for this purpose being the 5-hoe drill equipped with press wheels.

Crimson-clover seed must be covered, but not too deeply. In most soils it is not enough to depend on rain to effect a covering. An inch in sandy soils and half an inch in clay soils appear to be about the right depth. Shallow planting gives the best results in wet seasons and deep planting in time of drought. Broadcasted seed should be covered with a spike-tooth harrow or a weeder rather than a heavy harrow or a shovel cultivator. A harrow made of fairly stiff brush is often useful in loose soil.

CHOICE OF SEED.

As a rule, fresh crimson-clover seed is of good viability, and failure to secure a stand is not often caused by failure of the seed to grow. Unlike most clovers, crimson-clover seed absorbs water readily and sprouts quickly. There are practically none of the hard seeds which are so frequent in red clover and sweet clover, and a germination of 90 per cent in 48 hours is not uncommon. The seed deteriorates rapidly, however, and when more than 2 years old rarely shows a germination in excess of 50 per cent. Sometimes, when stocks of commercial seed are low, old seed finds its way to the market, and this, when planted, gives poor results. Old seed can usually be detected by the dull-brown appearance of the seed coat as contrasted with the bright, shiny, pinkish or greenish yellow color of fresh seed. Brown seed, however, is sometimes caused by weathering during harvest, and such seed is not objectionable unless the weathering has been excessive.

A common impurity in crimson-clover seed is green, shrunken, and immature seed, caused by harvesting the crop before it is ripe. Crimson-clover seed does not germinate readily until it takes on a yellowish tinge; therefore, green seed should be rejected.

Crimson-clover seed is larger and plumper than red-clover seed and if properly cleaned should not contain seeds of dodder or the smaller seeded weeds. Frequently, however, it does contain the seeds of field peppergrass, yellow trefoil, evening primrose, sheep sorrel, wild geranium, buttercups, mustards, and other weeds which blossom in early summer.

UNHULLED SEED.

There is a growing belief among farmers that they are less likely to lose a stand of crimson clover through drought if they sow the seed in the hull rather than use the hulled seed as it ordinarily appears on the market. It is claimed that the hulls hold the moisture to some extent and carry the seedlings over the critical day or two following germination, while some farmers assert that the unhulled seeds require more moisture for germination, and the seeds therefore do not sprout until there is enough moisture in the soil to keep the plants growing. Unhulled seed is bulky and is not often handled by commercial seedsmen, although one large grower sells the unhulled seed in compressed bales similar to small cotton bales. It usually can be secured from neighboring farmers, however, or is easily saved at home. The seed can be harvested with a stripper from the standing crop in the field or the mature crop can be cut and thrashed like an ordinary grain crop. For local planting on a small scale unhulled seed is the cheapest and most accessible form of crimson-clover seed.

Unhulled seed is somewhat difficult to sow, because the hairy hulls stick together in masses and can not be scattered uniformly. To avoid this trouble the seed may be mixed with moistened earth or with lime, or may be sown with a blower similar to those used on small forges. A better plan is to sow on a windy day, throwing the seed vertically into the air and allowing the wind to scatter it.

Of unhulled seed of the best quality, 100 pounds contains about 1 bushel (60 pounds) of clean seed. The common grades, however, are usually more chaffy and require 120 to 180 pounds to make a bushel. From 2 to 3 pounds of unhulled seed are therefore regarded as equivalent to 1 pound of hulled seed. A bushel of unhulled seed, even when

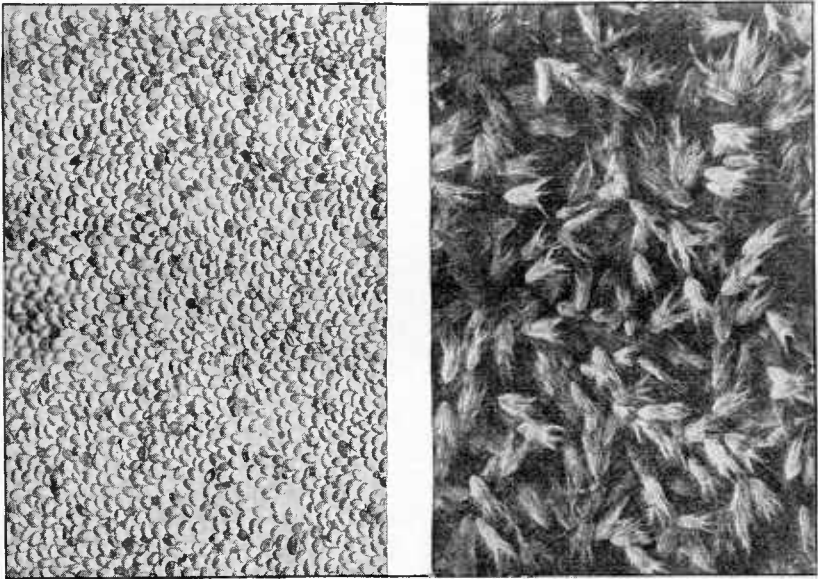


FIG. 7.—Hulled seed of crimson clover of a common commercial grade and unhulled seed gathered with a homemade stripper. (Natural size.)

well packed down, weighs only 6 to 10 pounds and contains about 4 pounds of seed. The appearance of both hulled and unhulled crimson-clover seed is shown in figure 7.

USE OF A NURSE CROP.

In order to protect the crimson-clover seedlings from the hot sun of late August it is a common practice in some sections to plant with the clover a small quantity of some quick-growing crop like buckwheat, cowpeas, rape, or turnips. A thin stand of these heavier leaved plants furnishes an ideal shade for the young clover, and on soils which are inclined to bake it prevents the formation of a crust. The nurse crop must be seeded lightly, usually not more than half the regular rate, as the ordinary stand shades the ground so com-

pletely as to destroy the crimson clover. On hot clay soil in the Piedmont region the chances of obtaining a stand of clover are about twice as good with a nurse crop as without one.

Buckwheat is the principal nurse crop northward from Washington, D. C. A common rate of seeding is 2 to 3 pecks of buckwheat in 15 pounds of crimson clover. If the planting can be made in July the buckwheat usually has time to ripen before frost and thus pay the cost of starting both stands.

In the cotton belt cowpeas have been used successfully, especially when seeding on fallow ground. They are seeded broadcast at the rate of one-half bushel per acre. There is ordinarily not enough time for the cowpeas to mature, but they add to the value of the stand for fall pasturage and protect the clover from severe weather in the winter. Both cowpeas and buckwheat have the merit of being able to grow on poor soil.

Dwarf Essex rape has been used as a nurse crop in a few cases where the clover was to be pastured by hogs or sheep in the fall. From 2 to 3 pounds of rape, sown in August, furnishes sufficient cover for a nurse crop. Cowhorn turnips, winter kale, and mustard are also satisfactory nurse crops if planted at a rate not exceeding 1 pound of seed per acre. If the clover is to be saved for seed these latter crops are objectionable, as a few plants will live over winter and ripen at the same time as the clover.

Where a nurse crop can not be grown conveniently, the crimson-clover seedlings can be protected from the sun by a light top-dressing of straw, spread just after the seed is sown.

SEED MIXTURES.

Crimson clover is frequently grown in combination with winter grain, hairy vetch, or other forage crops having a similar period of growth. The mixed crop is less liable to lodge than the single crop, cures more readily in damp weather, and usually furnishes a heavier yield. Another advantage of the mixed crop is that if either should fail the other will serve as a cover crop during the winter and bring some return the following spring. Mixed crops are not desirable if the clover is to be saved for seed.

South of central Virginia crimson clover is usually grown in combination with winter oats. An early variety of oats, such as the Fulghum, or a late variety of clover, such as the white blooming, is usually the best, as the oat crop matures somewhat later than the ordinary crimson clover. The customary rate of seeding is 15 pounds of the clover and $2\frac{1}{2}$ bushels of oats per acre. In Delaware and eastern Maryland the most popular companion crop for crimson clover is winter wheat, although barley makes a desirable hay crop and is sometimes used. Rye is not desirable for hay, but it is prob-

ably the best of the grains for green manure, as it is hardy, vigorous, and starts growth early in the spring. Rye and wheat are seeded at the rate of 1 bushel per acre with the customary quantity of crimson clover. The accompanying illustration (fig. 8) shows a field seeded to a mixture of crimson clover and wheat. Usually the grain is well headed, but in the milk or soft-dough stage, when the clover is ready to cut, the yield of the mixed crimson clover and grain is often 25 to 50 per cent greater than that of the clover alone.

Hairy vetch and crimson clover are sometimes grown together, seeding at the rate of 20 pounds and 10 pounds per acre, respectively. As both these plants are likely to lodge in good soil, however, one of the grains is usually included, a common seeding mixture being oats 2 bushels, hairy vetch 12 to 15 pounds, and crimson clover 5 pounds. Bur clover, black medic, and other winter-growing legumes are sometimes found in mixtures with crimson clover, although such mixtures generally occur by accident rather than intent. Black medic and crimson clover make a particularly good combination on rich soil.



FIG. 8.—Crimson clover and wheat in mixture. In the foreground the crop has been cut and fed green to stock. The remainder was cut the next day for hay. The grain prevents the crimson clover from lodging.

In most of the crimson-clover area the cultivated grasses, such as timothy, redtop, and orchard grass, are not commonly grown. However, where these grasses flourish they may well be seeded at the same time as the crimson clover, provided the latter is planted not earlier than September 15. In some sections Johnson grass and Bermuda grass make useful combinations with crimson clover, the grasses making most of their growth in the summer and the clover in the fall and spring.

TREATMENT OF THE STAND.

Ordinarily no special treatment is required after seeding and the clover goes into the winter without any further handling. If the growth is so rank that there is danger of the plants being too succulent to survive the winter, the tops can be reduced by light grazing with small animals, such as calves, sheep, or chickens, or by mowing with the cutter bar of the mowing machine set high. If the stand is backward, it may be stimulated by a light application of nitrate of soda. It is said that a thin stand can be thickened by grazing lightly with sheep, as the grazing induces heavier stooling. The aim should be to carry the clover into the winter with well-hardened leafy stems and with a well-established root system to withstand heaving out in the spring.

In fields which are to be saved for seed a wise precaution is to go over them early in the spring and chop out the weeds. If wild onion and other weeds are chopped off in April, they do not make enough growth by May to contaminate the seed crop.

MALADIES.

The only disease seriously affecting crimson clover is the clover stem-rot, root-rot, or wilt, a disease resembling the stem-rot, or wilt, of lettuce and other plants. This disease is prevalent in nearly all the crimson-clover States and sometimes does considerable damage. The stem-rot affects the clover at all seasons, but is more noticeable in the spring, when it sometimes causes large spots of clover suddenly to wilt and fall. Occasionally an entire field is affected, but the disease is most prevalent in low, rich spots. Examination of the plants discloses a rotting off or decay of the stems close to the ground, followed immediately by the appearance on the stems of small black lumps, or sclerotia, about the size of clover seed. These sclerotia are a means of spreading the disease and are often harvested in the hay or in the seed crop. The only known remedy for the stem-rot is to cease growing clover or alfalfa on an infested field for three or four years, substituting cowpeas or soy beans. Seed from fields known to be infested should, of course, be avoided.

No insects are known to affect crimson clover seriously, nor are weeds of great importance in clover planted on clean fields. When planted in cultivated crops or in poorly prepared ground crimson clover is often seriously damaged by a rank growth of chickweed, knawel (moss weed), winter cress, and other winter-growing annuals.

